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TITLE: AUTOMATIC TRANSMISSION FOR VEHICLES

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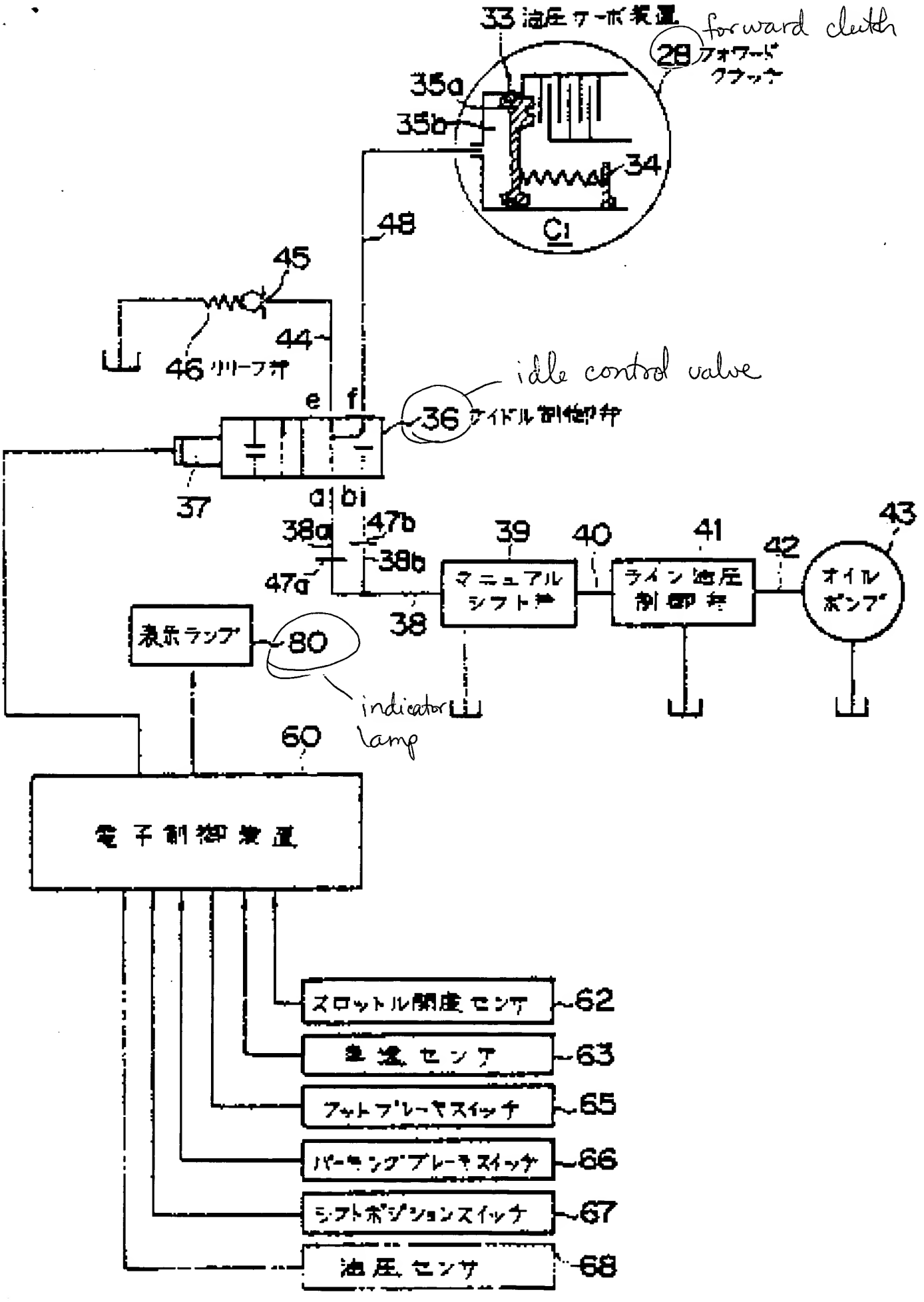
ABSTRACT:

PURPOSE: To make a driver discriminate of whether a car is in a forward traveling range or not, by displaying a fact that now an anticreep is acting.

CONSTITUTION: At idle running when a manual shift range is set to a forward traveling range, an idle control valve 36 is energized with a continuous rating current, and hydraulic pressure is fed to a forward clutch 28 of a geared transmission whereby anticreep control is carried out. During this anticreep action, periodically repeated blinks or illuminance changes

are displayed by an
indicator lamp 80. Therefore, a driver starts this car
upon awaiting the
indicator lamp 80 going out, whereby engaging load in the
forward clutch 28 is
made smaller so that durability is improved.


33 油圧サーボ装置
forward clutch
28 フォワードクラッチ
35a
35b
34
C1
48
45
44
46 リリーフ弁
idle control valve
e
f
36 アイドル制御弁
37
a
bi
38a
47b
38b
47a
38
39
マニュアルシフト弁
40
41
ライン油圧制御弁
42
43
オイルポンプ
表示ランプ
80
indicator lamp
60
電子制御装置
スロットル開度センサ
62
車速センサ
63
アップブレーキスイッチ
65
パーキングブレーキスイッチ
66
シフトポジションスイッチ
67
油圧センサ
68

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AUTOMATIC TRANSMISSION FOR A VEHICLE

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Specification

1. Title of the invention

Automatic transmission for a vehicle

2. Patent Claims

1. An automatic transmission for a vehicle with the following characteristics: In an automatic transmission for a vehicle which possesses a fluid-type torque converter, a gear transmission unit which can be switched among multiple transmission steps based on the engagements and disengagements of multiple frictional coupling units, and an anti-creep control mechanism the manual shift range of which is designated to coincide with the forward drive range and which prevents the generation of a creep during an idle operation mode whereby a vehicle is virtually still,

The aforementioned anti-creep control mechanism possesses a display device which displays the pervasion of its anti-creep function.

2. An automatic transmission for a vehicle with the following characteristics: In the automatic transmission for a vehicle specified in Patent Claim 1, the aforementioned display device is of the optical type and is constituted to flash repeatedly at a

[1] Numbers in the margin indicate pagination in the foreign text.

certain periodic frequency under the pervasion of the anti-creep function.

3. An automatic transmission for a vehicle with the following characteristics: In the automatic transmission for a vehicle specified in Patent Claim 1, the aforementioned display device is of the optical type and is constituted to exhibit repeated luminosity fluctuations at a certain periodic frequency under the pervasion of the anti-creep function.

4. An automatic transmission for a vehicle with the following characteristics: In the automatic transmission for a vehicle specified in any one of Patent Claims 1 through 3, the aforementioned display device is constituted

To initialize the display of the in-progress status of the anti-creep function upon the passage of a certain period since the temporal stage where an anti-creep control command becomes issued to the aforementioned anti-creep control mechanism and

To conclude the display of the in-progress status of the anti-creep function upon the passage of a certain period since the temporal stage where an anti-creep control cancellation command becomes issued to the aforementioned anti-creep control mechanism.

5. An automatic transmission for a vehicle with the following characteristics: In the automatic transmission for a vehicle specified in any one of Patent Claims 1 through 3, the aforementioned anti-creep control mechanism is constituted

To serve its anti-creep function by designating the coupling pressure of a forward clutch of the hydraulic drive format for the

aforementioned gear transmission unit at a value lower than the value prevailing at the time of the achievement of the forward transmission step, /2

To render the display of the in-progress status of the anti-creep function at a stage where the hydraulic pressure of the aforementioned forward clutch has dropped below a certain threshold, and

To terminate the display of the in-progress status of the anti-creep function at a stage where the hydraulic pressure of the aforementioned forward clutch has exceeded [said] certain threshold.

6. An automatic transmission for a vehicle with the following characteristics: In the automatic transmission for a vehicle specified in Patent Claim 2 or 3, the aforementioned display device is shared as a shift position indicator lamp which displays the manual shift range.

7. An automatic transmission for a vehicle with the following characteristics: In the automatic transmission for a vehicle specified in Patent Claim 1, the aforementioned display device is shared as a shift position indicator lamp which displays the manual shift range and is constituted to change the light emission color under the pervasion of the anti-creep function in contradistinction with a state characterized by its non-pervasion.

8. An automatic transmission for a vehicle with the following characteristics: In the automatic transmission for a vehicle specified in Patent Claim 2 or 3, the aforementioned display

device is constituted to vary the periodic frequency of its flashing or luminosity fluctuation at the times of the failures of various sensors.

3. Detailed explanation of the invention

(Industrial application fields)

The present invention concerns an automatic transmission for a vehicle (e.g., automobile, etc.), and in particular, it concerns an automatic transmission for a vehicle equipped with an anti-creep control mechanism.

(Prior art)

Generally speaking, an automatic transmission for a vehicle (e.g., automobile, etc.) possesses not only a fluid-type torque converter to which a rotating power becomes transmitted from an internal combustion system but also a gear transmission unit of the comet gear type which can be switched among multiple transmission steps based on the engagements and disengagements of multiple frictional coupling units, whereas the aforementioned gear transmission unit is constituted to switch among transmission steps in compliance with a preliminarily designated transmission pattern in accordance with the vehicle speed and/or the depression magnitude of the accelerator pedal.

Generally speaking, in a case where the manual shift range of the automatic transmission of the prior art for a vehicle is

designated to coincide with a drive range (e.g., D range, etc.), the depression of the accelerator pedal becomes cancelled, as a result of which the neutral state of the aforementioned gear transmission unit does not become achieved even if the vehicle speed is virtually zero (e.g., idle operation mode), but rather, it is designated to coincide with the first speed step, due to which the vehicle becomes propelled in a favorable responsiveness in response to the depression of the accelerator pedal; in a case where the aforementioned gear transmission unit is designated to coincide with the first speed step during the idle operation mode, however, the output of the internal combustion system becomes transmitted, via the fluid-type torque converter, to the forward drive input component of the aforementioned gear transmission unit, due to which significant idle vibrations become generated, accompanied by the arising of a creep, and it becomes necessary, in the context of stopping the vehicle completely, to depress the brake pedal with a rather substantial force and to invoke the braking action of the brake which controls the drive of the vehicle; the fuel economy during the idle operation mode, furthermore, becomes exacerbated by the concomitant pull and friction of the fluid-type torque converter, and the temperature of the action oil for the fluid-type torque converter is also known to become elevated.

As far as frictional coupling devices for the aforementioned gear transmission units which are designed, in acknowledgment of the aforementioned problems, to achieve a neutral state or a

neutral equivalent state for said gear transmission unit during the idle operation mode, whereby the manual shift range is designated to coincide with the forward drive range and whereby the vehicle is virtually still, are concerned,

An automatic transmission for a vehicle constituted

To release a so-called "forward clutch," which selectively connects an output component for a fluid-type torque converter and a forward vehicle drive input component for a gear transmission unit,

To designate the coupling pressure of said forward clutch at a magnitude lower than that prevailing at the time of the achievement of the forward transmission step, which is selected to the extent that the slip of said forward clutch will become induced, and/or

To possess an anti-creep control mechanism which precludes the transmission of the output torque of a fluid-type torque converter to a forward vehicle drive input component for a gear transmission unit

Has already been proposed in

Japanese Patent Application No. Tokugan Sho 41[1966]-18128 (Japanese Patent Publication No. Kokoku Sho 47[1972]-19962), Japanese Patent Application No. Tokugan Sho 56[1981]-17742 (Japanese Patent Application Publication No. Kokai Sho 56[1981]-21047), Japanese Patent Application No. Tokugan Sho 57[1982]-10444 (Japanese Patent Application Publication No. Kokai Sho 58[1983]-128552), Japanese Patent Application No. Tokugan Sho 57[1982]-

75829 (Japanese Patent Application Publication No. Kokai Sho 58[1983]-193953), Japanese Patent Application No. Tokugan Sho 57[1982]-115087 (Japanese Patent Application Publication No. Kokai Sho 59[1984]-6454), and Japanese Patent Application No. Tokugan Sho 59[1984]-176300.

These automatic transmissions for vehicles thus proposed in earlier patent applications are capable of achieving the prescribed objectives, and as far as these automatic transmissions for vehicles are concerned, furthermore, idle vibrations are minimized, accompanied by the prevention of the generation of a creep; moreover, the vehicle can be completely stopped even if the brake /3
pedal is not firmly depressed, and since the pull and friction of the fluid-type torque converter are absent in this case, the fuel economy of the idle operation mode becomes improved, and the temperature gain of the action oil for the fluid-type torque converter can also be avoided.

(Problems to be solved by the invention)

As has been mentioned above, in a case where the anti-creep control (neutral control) becomes executed, no creep becomes generated during the idle operation mode even if the manual shift range is designated to coincide with a drive range (e.g., D range, etc.), and accordingly, it becomes more difficult for an operator to judge the pervasion of the neutral (N) range or forward drive range as the manual shift range in actuality depending either on

the stop status of the vehicle or on the depression magnitude of the vehicular drive braking foot brake pedal, which may in turn intensify the sense of uncertainty on the part of the operator.

The objective of the present invention is to provide an automatic transmission for a vehicle which has solved and/or alleviated the problems discussed above.

(Mechanism for solving the problems)

The aforementioned objective of the present invention can be achieved by an automatic transmission for a vehicle with the following characteristics: In an automatic transmission for a vehicle which possesses a fluid-type torque converter, a gear transmission unit which can be switched among multiple transmission steps based on the engagements and disengagements of multiple frictional coupling units, and an anti-creep control mechanism the manual shift range of which is designated to coincide with the forward drive range and which prevents the generation of a creep during an idle operation mode whereby a vehicle is virtually still,

The aforementioned anti-creep control mechanism possesses a display device which displays the pervasion of its anti-creep function.

(Functions and effects of the invention)

As far as the automatic transmission of the present invention for a vehicle is concerned, the in-progress status of the anti-

creep function is displayed, during its pervasion, by the display device, and this display device therefore enables the operator to correctly acknowledge the pervasion or lack thereof of the in-progress status of the anti-creep function. It is thus that the operator can judge whether the currently prevailing manual shift range coincides with the N range or forward drive range.

Various ones are conceivable as display devices, and in cases where optical ones are selected, it is desirable to invoke repeated flashing actions or luminosity fluctuations at a certain periodic frequency for the purpose of informing the operator of the pervasion of the in-progress status of the anti-creep function without forcing the operator to consciously view the display device, and such a device may, furthermore, be shared as a shift position indicator which displays the manual shift range.

(Application examples)

In the following, application examples of the present invention will be explained in detail with reference to attached figures.

Figure 1 shows an abstracted constitution of a general automatic transmission for a vehicle. The automatic transmission (1) is constituted to possess not only

The fluid-type torque converter (2), which in turn possesses the pump fan wheel (3), the turbine fan wheel (4), the stator fan wheel (5), and the direct coupling clutch (6), namely a general

direct coupling clutch of the triple element/single step/double phase type, but also

The gear transmission unit (7), which serves as an auxiliary transmission unit, whereas

The pump fan wheel (3), which serves as the input component for the fluid-type torque converter (3) [sic: Presumably "(2)"], is linked, in a drivable fashion, to the output axle (101) of the internal combustion system (100), whereas the turbine fan wheel (4), which serves as the output component for the fluid-type torque converter (2), is linked, in a drivable fashion, to the input axle (9) of the gear transmission unit (7), whereas the output axle (8) of the gear transmission unit (7) is linked, in a drivable fashion, to a drive wheel (not shown in the figure) via a differential gear unit.

The gear transmission unit (7) possesses the auxiliary gear transmission unit (10) and the main gear transmission unit (11), which are mutually linked serially.

The auxiliary gear transmission unit (10) includes

The sun gear (12),

The ring gear (13), which is configured coaxially with the sun gear (12),

The planetary pinion (14), which is configured between the sun gear (12) and ring gear (13) while being engaged with both gears,

The carrier (15), which supports the planetary pinion (14) in a rotatable fashion,

The one-way clutch (F_0) (16), which prohibits the rotation of the carrier (15) toward the left in relation to the sun gear (12),

The OD clutch (C_0) (17), which selectively links the sun gear (12) and carrier (15), and

The OD brake (B_0) (18), which selectively fixes the sun gear (12) to a transmission case, whereas the carrier (15) is linked, in a drivable fashion, to the input axle (9), whereas

A switch between a pair of transmission steps is invoked based on the selective coupling of the OD clutch (17) and the OD brake (18). /4

The main gear transmission unit (11) possesses

The front sun gear (20) and the rear sun gear (21), which are mutually linked via the intermediate axle (19),

The front ring gear (22), which is configured coaxially to the front sun gear (20),

The rear ring gear (23), which is configured coaxially to the rear sun gear (21),

The front planetary pinion (24), which is configured between the front sun gear (20) and the front ring gear (22) while being engaged with both gears,

The rear planetary pinion (25), which is configured between the rear sun gear (21) and the rear ring gear (23) while being engaged with both gears,

The front carrier (26), which supports, in a rotatable fashion, the front planetary pinion (24),

The rear carrier (27), which supports, in a rotatable fashion, the rear planetary pinion (25),

The forward clutch (C_1) (28), which selectively connects, under the pervasion of a torque transmission relationship, the front ring gear (22), which serves as the forward drive input component for the main gear transmission unit (11), and the ring gear (13), which serves as the output component for the auxiliary gear transmission unit (10),

The direct clutch (C_2) (29), which selectively connects, under the pervasion of a torque transmission relationship, the intermediate axle (19) and the ring gear (13),

The shift brake (B_1) (30), which selectively fixes the intermediate axle (19) to the transmission case,

The other shift brake (B_2) (31), which selectively fixes the rear carrier (27) to the transmission case, and

The one-way clutch (F_1) (32), which locks the leftwise rotation of the rear carrier (27), whereas

The front carrier (26) and the rear ring gear (23) are linked, in a drivable fashion, to the output axle (8), whereas specified combinations of the aforementioned multiple number of clutches and the aforementioned multiple number of brakes are designated to become engaged and/or disengaged, based on which the transmission step can be switched among multiple numbers, namely three forward steps and one backward step.

The gear transmission unit (7) selectively achieves, by virtue of the coordinated operations of the auxiliary gear

transmission unit (10) and the main gear transmission unit (11), a transmission step selected from multiple numbers, namely five forward steps (including the overdrive step) and one backward step, based on the engagements and disengagements of the multiple clutches and multiple brakes of the auxiliary gear transmission unit (10) and the main gear transmission unit (11) in compliance with the respective orders shown in the table below.

//Insert Table: (1): Range & transmission step; (P): Parking; (R): Reverse; (N): Neutral; (D): D range; (i): First speed; (ii): Second speed; (iii): Third step; (iv): Fourth step; (v): Fifth step [illegible]//

The signs in the foregoing table signify the following: O: Engaged state of the clutch or brake in question; x: Disengaged state of the clutch or brake in question; Δ: The one-way clutch in question is engaged (locked) under the pervasion of the engine drive mode, whereby the drive wheel becomes driven and is disengaged (free) under the pervasion of the engine brake mode, whereby the internal combustion system becomes driven from the drive wheel side.

Incidentally, no upward shifting action to the second speed step is invoked in the L range, and only a down-shift action from the second to first speed steps is invoked.

The clutches (17), (28), and (29) and the brakes (18), (30), and (31) of the auxiliary gear transmission unit (10) and main

gear transmission unit (11) are each of the hydraulic operation format and constituted to be driven by a hydraulic servo device and to become engaged selectively, whereas

The transmission step of the gear transmission unit (7) is permutatively designated,

Under the control not only of a hydraulic control device which controls the hydraulic input and/or output actions in relation to the aforementioned hydraulic servo device but also of an electronic control device which includes a microcomputer which commands the switch of the oil paths of said hydraulic control device,

By invoking engagement and disengagement actions of the aforementioned combinations of the aforementioned clutches and the aforementioned brakes

In compliance with a general and conventionally known transmission pattern which has preliminarily been determined depending on the vehicular speeds and throttle apertures specific to the respective manual shift ranges.

Figure 2 shows major constituent components of one application example of the /5
automatic transmission of the present invention for a vehicle. The aforementioned hydraulic control device, which is used for transmission control purposes, possesses the idle control valve (36), which becomes switched by the solenoid (37), whereas one port, namely "a," of said idle control valve is connected to the forward port of the manual shift valve (39) via the oil path (38a)

and the oil path (38), between which is configured the constriction (47a), whereas its other port, namely "b," is connected to the same via the oil path (38b) and the oil path (38), between which is configured the constriction (47b), whereas these ports are constituted to feed a line oil pressure constantly via the manual shift valve (39) in a case where the designated manual shift range coincides with a forward drive range such as the D range, S range, and L range. Incidentally, the manual shift valve (39) is connected, by the oil path (40), to the line oil pressure control valve (primary regulator valve) (41), whereas the line oil pressure control valve (41) is connected, by the oil path (42), to the oil pump (43).

Apart from said ports "a" and "b," the idle control valve (36) possesses an additional pair of ports "e" and "f," whereas the port "e" is connected to the relief valve (46), which possesses the oil path (44) and the port (45), whereas the port "f" is connected, by the oil path (48), to the oil chamber (35b) of the hydraulic servo unit (33) of the forward clutch (28). In a case where a current is being permeated through the solenoid unit (37), the idle control valve (36) not only connects the port "a" with the port "e" but also connects the port "e" with the port "f," as the figure indicates, whereas in a case where no current is being permeated through the solenoid unit (37), it disconnects the port "f" from the port "e" and then connects the former with the port "b."

In a case where a current becomes permeated through the solenoid (37) of the idle control valve (36) at a stage where the manual shift range coincides with the forward drive range (e.g., D range, etc.), therefore, an oil pressure which is lower than the line oil pressure and which is determined by the designated relief pressure of the relief valve (46) becomes fed into the oil chamber (35b) of the forward clutch (28), whereas in contrast, the line oil pressure becomes fed into the oil chamber (35b) in a case where no current is being permeated through the solenoid (37).

The hydraulic servo unit (33) of the forward clutch (28) is constituted

To include the servo piston (35a),

To invoke the engagement action of the forward clutch (28) based on the shift of the servo piston (35a) toward the right in the figure in opposition to the spring force of the return spring (34), which is proportional to the increase of the oil pressure fed into the oil chamber (35b), and

To increase the clutch engagement pressure in accordance with the increase of the oil pressure within the oil chamber (35b).

The relief pressure of the relief valve (46) is designated to be equal to the servo oil pressure that prevails immediately before the commencement of the positive torque transmission of the forward clutch (28), and for this reason, in a case where an oil pressure equal to the designated relief pressure of the relief valve (46) is being fed into the oil chamber (35b) of the forward clutch (28), the forward clutch (28) can be designated to abide in

a state which is capable of yielding a slip immediately before the commencement of the positive torque transmission. It is thus that the anti-creep control becomes exerted. Incidentally, in a case where the line oil pressure has become fed into the oil chamber (35b) of the forward clutch (28), the forward clutch (28) becomes characterized by a completely engaged state, based on which it connects, under the pervasion of a perfect torque transmission relationship, the ring gear (13) of the auxiliary gear transmission unit (10) and the front ring gear (22) of the main gear transmission unit (11) without entailing a slip.

The permeation of a current through the solenoid (37) of the idle control valve (36) is designed to be controlled by the electronic control unit (60). The electronic control unit (60) is constituted

To include a general microcomputer,

To procure a set of information on the aperture of the throttle valve of the internal combustion system (100) from the throttle aperture sensor (62), a set of information on the vehicle speed from the vehicular speed sensor (63), a set of information on the pervasion or lack thereof of the control action of the foot brake pedal, which is orchestrated for vehicular drive braking purposes, from the foot brake switch (65), a set of information on the pervasion or lack thereof of the control action of the parking brake pedal, which is orchestrated for vehicular drive braking purposes, from the parking brake switch (66), and a set of

information on the manual shift range from the shift position switch (67), and

To control the permeation of the current through the solenoid (37) in compliance with the flow chart shown in Figure 4.

The display lamp (80), which displays the pervasion of the in-progress status of the anti-creep function, is configured within the vehicular chamber. The display lamp (80) may, for example, be constituted to be configured on an instrument panel in front of the operator's seat and to invoke repeated flashing or luminosity fluctuation cycles at a specified periodic frequency under the pervasion of the anti-creep function.

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This display lamp (80) may also be shared as a shift position indicator lamp, and said display lamp may also be constituted to change the light emission color under the pervasion of anti-creep function in contradistinction with a state characterized by the non-pervasion of the same.

The display lamp (80) may, furthermore, be constituted to vary the flashing or luminosity fluctuation periodic frequency at the times of the failures of various sensors and to display such failed statuses of the various sensors.

Figure 3 shows an application example of major constituent units of the automatic transmission of the present invention for a vehicle, namely an anti-creep control circuit and a display lamp drive circuit. In Figure 3, the respective notations signify the

following: (81): AND circuit; (82): OR circuit; (83): Transistor; (84): Delay circuit; (85): Oscillation circuit; (86): Transistor.

In a case where the conditions for executing the anti-creep control of this electric circuit become fulfilled, the AND circuit (81) becomes characterized by an ON state, as a result of which a current becomes permeated through the solenoid (37), whereas the oscillating actions of the oscillation circuit (85) become invoked at a certain periodic frequency upon the passage of a specified period which is determined by the delay circuit (84) since the stage where the AND circuit (81) has become characterized by the ON state, and the display lamp (80) comes to flash in response to said oscillating actions, whereas in a case where the conditions for executing the anti-creep control are no longer fulfilled, the AND circuit (81) becomes characterized by an OFF state, as a result of which the current permeation through the solenoid (37) becomes terminated, and furthermore, the oscillating actions of the oscillation circuit (85) become stopped upon the passage of a specified period which is determined by the delay circuit (84) since the stage where the AND circuit (81) has become characterized by the OFF state, and the display lamp (80) becomes unlit.

The delay times for the actions of the display lamp (80) mandated at the respective stages of the initialization and completion of the anti-creep control routine are designated in accordance not only with

The time required for the actual achievement of the uncoupled state of the forward clutch (28) since [the beginning of] the current permeation through the solenoid (37) but also with

The time required for the actual achievement of the coupled state of the forward clutch (28) since the termination of the current permeation through the solenoid (37), whereas

These values may be designated to be either constant or variable in accordance with the types of oils.

Next, application procedures for controlling the current permeations through the solenoid (37) and display lamp (80) will be explained with reference to the flow chart shown in Figure 4. The routine of the flow chart shown in Figure 4 is repeated at a specified time interval or a specified crank angle interval.

It is judged at the step 100 whether or not the prevailing manual shift range coincides with a forward drive range such as the D range, S range, and L range. In a case where the manual shift range has been judged to coincide with the forward drive range, an advancement to the step 101 is made, whereas in a case where the manual shift range has been judged not to coincide with the forward drive range, namely to coincide with the P range, R range, or N range, an advancement to the step 109 is made.

It is judged at the step 101 whether or not the throttle valve is fully closed, namely whether or not it is located at the idle aperture position. In a case where the throttle valve has been judged to be located at the idle aperture position, an advancement to the step 102 is made, whereas in contrast, in a

case where the throttle valve has been judged not to be located at the idle aperture position, an advancement to the step 109 is made.

It is judged at the step 102 whether or not the vehicular speed is at or below a certain extremely low threshold close to zero. In other words, it is judged whether or not the vehicular speed is virtually zero. In a case where the vehicular speed has been judged to be equal to or lower than the aforementioned threshold, an advancement to the step 103 is made, whereas in a case where the vehicular speed has been judged to be neither equal to nor lower than the aforementioned threshold, an advancement to the step 109 is made.

It is judged at the step 103 whether or not the braking action of at least either of the foot brake and parking brake is being invoked. In a case where a vehicle braking phase over which the braking action of the foot brake or parking brake is being invoked is in progress, an advancement to the step 104 is made, whereas in a case where such a vehicle braking phase is not in progress, an advancement to the step 109 is made.

It is judged at the step 104 whether or not the flag F_1 is "1." In a case where $F_1 = 1$ has been judged, the current permeation through the solenoid (37) and the anti-creep control mechanism have already been executed, and in this case, an advancement to the step 106 is made, whereas in a case where $F_1 = 1$ has not been judged, an advancement to the step 105 is made.

A current is permeated through the solenoid (37) of the idle control valve (36) at the step 105. The status of the flag F_1 is concomitantly permutated into "1." As a result, a specified oil pressure which is determined by the relief valve (46) and which is lower than the line oil pressure becomes fed into the oil chamber (35b) of the forward clutch (28), whereas the coupling pressure /7

of the forward clutch (28) becomes designated at a level which is lower than that prevailing at the time of the achievement of the forward transmission step to the extent that the slip of said forward clutch will become induced.

At this juncture, the coupling pressure of the forward clutch (28) is, as has been mentioned above, designated at a level which is lower than that prevailing at the time of the achievement of the forward transmission step to the extent that the slip of said forward clutch will become induced, and accordingly, the transmission of the output torque of the engine (2) to the front ring gear (22), namely the forward drive input component for the gear transmission unit (7), becomes precluded, as a result of which the idle vibrations become mitigated, and the generation of a creep becomes prevented.

It is judged at the step 106 whether or not the specified time Ts has elapsed since the permutation of the status of the flag F_1 from "0" to "1." Said specified time Ts is designated in accordance with the time necessary for the actual achievement of the uncoupled state of the forward clutch (28) in response to the

loss of the oil pressure within the oil chamber (35b) of the hydraulic servo unit (33) since [the beginning of] the current permeation through the solenoid (37), and in a case where $T \geq Ts$ holds, an advancement to the step 107 is made, whereas in a case where $T \geq Ts$ does not hold, the anti-creep control routine is concluded.

It is judged at the step 107 whether or not the status of the flag F_2 is "1." In a case where $F_2 = 1$ holds, the flashing action of the transistor (83) has already been invoked, and in this case, the anti-creep control routine is concluded, whereas in contrast, in a case where $F_2 = 1$ does not hold, an advancement to the step 108 is made.

A current is permeated through the oscillation circuit at the step 108. The status of the flag F_2 is also permutated into "1" at this step. As a result, the oscillating actions of the oscillation circuit become invoked at a certain periodic frequency, and the display lamp (80) comes to flash in response to said oscillating actions, based on which the operator becomes informed of the pervasion of the anti-creep function.

It is judged at the step 109 whether or not the status of the flag F_1 is "1." In a case where the status of the flag is $F_1 = 1$, an advancement to the step 110 is made, whereas in contrast, in a case where the status of the flag is not $F_1 = 1$, the anti-creep control routine is concluded.

The current permeation through the solenoid (37) of the idle control valve (36) is terminated at the step 110, and the status

of the flag F_1 is also permutated into "0." In a case where the concomitantly prevailing manual shift range coincides with the forward drive range, the current permeation through the solenoid (37) of the idle control valve (36) becomes stopped, as a result of which the line oil pressure becomes fed into the oil chamber (35b) of the forward clutch (28), and since the perfectly coupled state for the torque transmission of the forward clutch (28) becomes achieved, the normal first speed step becomes realized.

It is judged at the step 111 whether or not the specified time Te has elapsed since the permutation of the status of the flag F_1 from "1" into "0." Said specified time Te is designated in accordance with the time necessary for the actual achievement of the coupled state of the forward clutch (28) in response to the increase of the oil pressure of the oil chamber (35b) of the hydraulic servo unit (33) up to the line oil pressure since the termination of the current permeation through the solenoid (37), and in a case where $T \geq Te$ holds, an advancement to the step 112 is made, whereas in a case where $T \geq Te$ does not hold, the anti-creep control routine is concluded.

It is judged at the step 112 whether or not the status of the flag F_2 is "1." In a case where the status of the flag is $F_2 = 1$, an advancement to the step 113 is made, whereas in contrast, in a case where the status of the flag is not $F_2 = 1$, the anti-creep control routine is concluded.

The current permeation through the oscillation circuit is terminated at the step 113, as a result of which the display lamp

(80) becomes unlit. The status of the flag F_2 is also permutated into "0" at this step.

In a case where the current permeation through the display lamp (80) is controlled in compliance with the aforementioned flow chart, the display lamp (80) flashes repeatedly at a certain periodic frequency only under the pervasion of the anti-creep function upon the actual achievement of the uncoupled state of the forward clutch (28), based on which the operator becomes informed of the pervasion of the anti-creep function. In a case where the vehicle is propelled in acknowledgment of this unlighting stage of the display lamp (80), namely the secure coupling of the forward clutch (28), the coupling load for the forward clutch (28) can be alleviated, and the durability of the forward clutch (28) can be improved.

As far as the aforementioned application example is concerned, an attempt is made to optimize the display period by orchestrating a delay time for the current permeation control of the display lamp (80), although the present invention is not limited to this embodiment, and the /8
action of the display lamp (80) may instead be controlled in accordance with the oil pressure of the oil chamber (35b) of the hydraulic servo unit (33) of the forward clutch (28). In this case, the oil pressure sensor (68) for detecting the oil pressure of the oil chamber (35b) of the hydraulic servo unit (33) is configured, and the control routine is executed in compliance with the flow chart shown in Figure 5.

Next, the flow chart shown in Figure 5 will be explained. Incidentally, the explanations of steps of the flow chart of Figure 5 at which routines virtually identical to those of the flow chart of Figure 4 are executed will be dispensed with.

As far as this flow chart is concerned, It is judged at the step 106 whether or not the oil pressure P of the oil chamber (35b) of the hydraulic servo unit (33) is lower than the specified value P_1. The specified value P_1 coincides with the designated forward clutch decompression value, which is determined not only by the spring force of the relief valve (46) but also by the area of the constriction port (45), whereas said specified value P_1 may be simultaneously designated at a level slightly higher than said designated decompression value during the present control routine.

It is judged at the step 111, furthermore, whether or not the oil pressure P of the oil chamber (35b) of the hydraulic servo unit (33) is higher than the specified value P_2. The specified value P_2 coincides with the line oil pressure of a case where the depression of the accelerator pedal is cancelled, whereas said specified value P_2 may be safely designated at a level slightly lower than the line oil pressure during the present control routine.

Incidentally, the modality of the anti-creep control of the automatic transmission of the present invention for a vehicle is not limited to the achievement of an uncoupled state for the forward clutch, and the anti-creep control may also be rendered by various other methods (e.g., upward shift of the gear transmission

unit, capacity reduction of the fluid-type torque converter, etc.).

The present invention has been explained in detail with reference to specific application examples above, although it is evident to persons of trade that the present invention is not limited to these embodiments and that the present invention can be embodied in variously modified fashions without deviating from its scope.

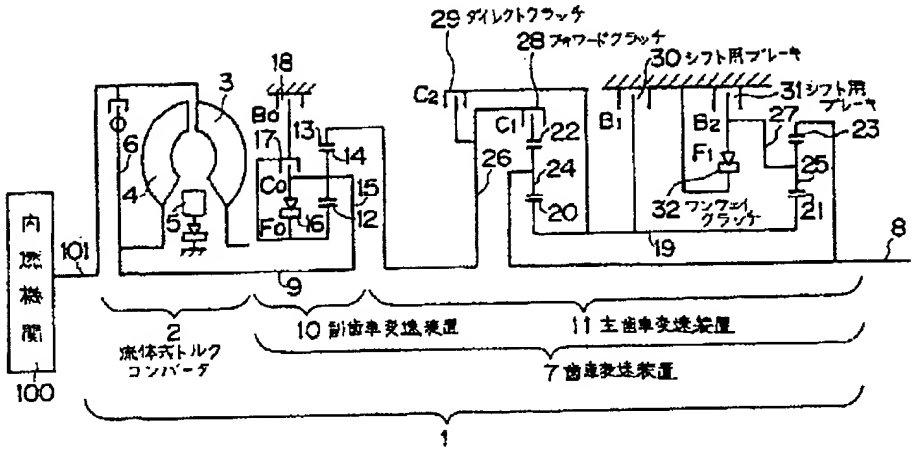
4. Brief explanation of the figures

Figure 1 is an approximate constitutional diagram which shows a general automatic transmission for a vehicle, whereas Figure 2 is an approximate constitutional diagram which shows major constituent components of one application example of the automatic transmission of the present invention for a vehicle, whereas Figure 3 is an electric circuit diagram which shows one application example of major constituent components of the automatic transmission of the present invention for a vehicle, namely an anti-creep control circuit and a display lamp drive circuit, whereas Figure 4 is a flow chart which shows an example of the application procedures of an anti-creep control routine, whereas Figure 5 is a flow chart which shows another example of the application procedures of an anti-creep control routine.

(1): Automatic transmission for a vehicle; (2): Fluid-type torque converter; (3): Pump fan wheel; (4): Turbine fan wheel; (5): Stator fan wheel; (6): Direct coupling clutch; (7): Gear

transmission unit; (8): Output axle; (9): Input axle; (10): Auxiliary gear transmission unit; (11): Main gear transmission unit; (12): Sun gear; (13): Ring gear; (14): Planetary pinion; (15): Carrier; (16): Output terminal; (17): OD clutch; (18): OD brake; (19): Intermediate axle; (20): Front sun gear; (21): Rear sun gear; (22): Front ring gear; (23): Rear ring gear; (24): Front planetary pinion; (25): Rear planetary pinion; (26): Front carrier; (27): Rear carrier; (28): Forward clutch; (29): Direct clutch; (30) and (31): Shift brakes; (32): One-way clutch; (33): Hydraulic servo unit; (34): Return spring; (35a): Servo piston; (35b): Oil chamber; (36): Idle control valve; (37): Solenoid; (38), (38a), and (38b): Oil paths; (39): Manual shift valve; (40): Oil path; (41): Line oil pressure control valve; (42): Oil path; (43): Oil pump; (44): Oil path; (45): Constriction port; (46): Relief valve; (47a) and (47b): Constrictions; (48): Oil path; (60): Electronic control unit; (62): Throttle aperture sensor; (63): Vehicular speed sensor; (65): Foot brake switch; (66): Parking brake switch; (67): Shift position switch; (68): Oil pressure sensor; (80): Display lamp; (81): AND circuit; (82): OR circuit; (83): Transistor; (84): Delay circuit; (85): Oscillation circuit; (86): Transistor; (100): Internal combustion system; (101): Output axle.

第 1 図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31 シフト用ブレーキ
18
3
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C1
B1
B2
F1
22
23
24
25
26
27
20
21
32 ワンウェイクラッチ
19
8
6
4
5
17
13
14
15
12
16
101
9
2
流体式トルクコンバータ
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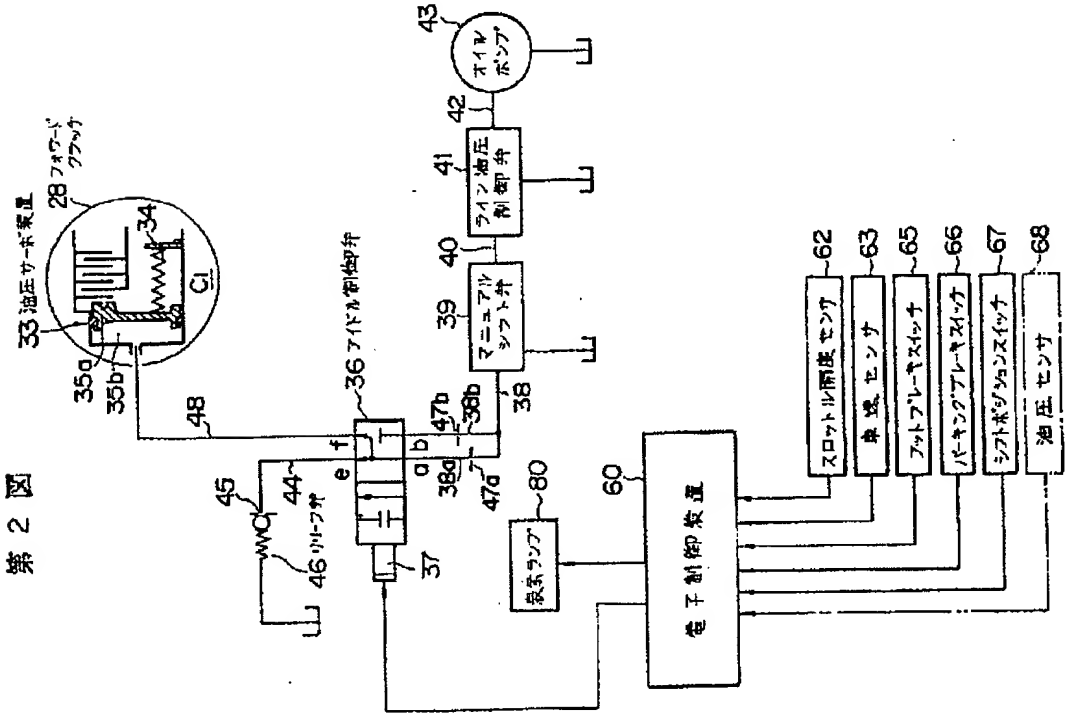
11 主歯車変速装置
7 歯車変速装置
100
1

第 2 図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28 フォワードクラッチ
33 油圧サーボ装置
34
C1
35a
35b
48
47b
38b
38a
47a
f
e
a
b
45
44
リーク弁
46
37
80
最高ランプ
60
電子制御装置
62
スロットル開度センサ
63
車速センサ
65
フットブレーキスイッチ
66
パーキングブレーキスイッチ
67
シフトポジションスイッチ
68
油圧センサ

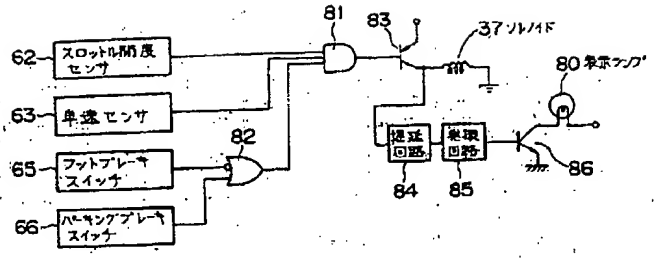
Figure 1 /9

[(2): Fluid-type torque converter; (7): Gear transmission unit; (10): Auxiliary gear transmission unit; (11): Main gear transmission unit; (28): Forward clutch; (29): Direct clutch; (30) and (31): Shift brakes; (32): One-way clutch; (100): Internal combustion system]

Figure 2

[(28): Forward clutch; (33): Hydraulic servo unit; (39): Manual shift valve; (41): Line oil pressure control valve; (43): Oil pump; (46): Relief valve; (60): Electronic control unit; (62): Throttle aperture sensor; (63): Vehicular speed sensor; (65): Foot brake switch; (66): Parking brake switch; (67): Shift position switch; (68): Oil pressure sensor; (80): Display lamp]

第 3 図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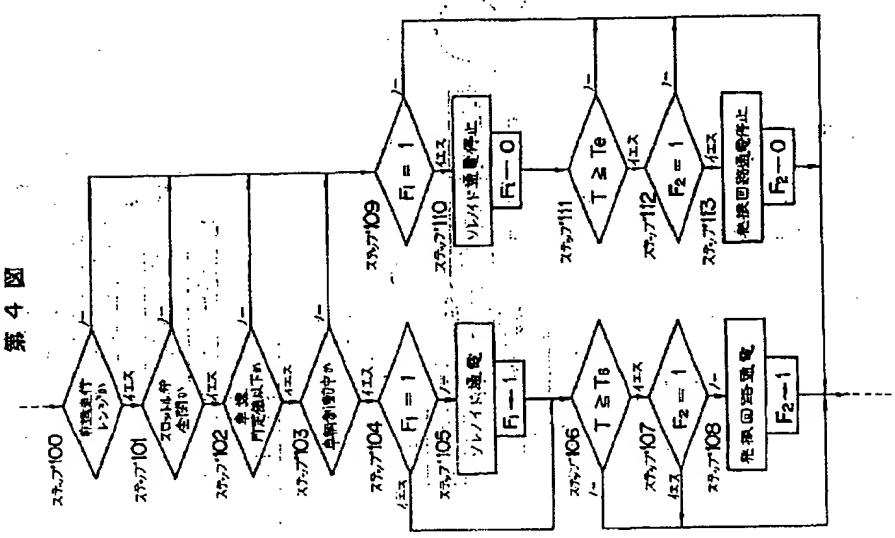
パーキングブレーキスイッチ
81
82
83
37 ソレノイド
80 表示ランプ
84
85
86

第 4 図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ステップ110
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ステップ112
ステップ113
F1 = 1
F1 — 1
T ≧ Tθ
F2 = 1
F2 — 1
F2 — 0
ソレノイド通電
ソレノイド通電停止
発振回路通電
発振回路通電停止

/10

Figure 3

[(37): Solenoid; (62): Throttle aperture sensor; (63): Vehicular speed sensor; (65): Foot brake switch; (66): Parking brake switch; (80): Display lamp; (84): Delay circuit; (85): Oscillation circuit]

Figure 4

[(S): Step; (N): No; (Y): Yes; (1): Forward drive range; (2): Is the throttle valve fully closed?; (3): Is the vehicular speed equal to or below the specified threshold?; (4): Is the vehicular braking action in progress?; (5): Solenoid current permeation; (6): Oscillation circuit current permeation; (7): Solenoid current permeation termination; (8): Oscillation circuit current permeation termination]

第 5 図

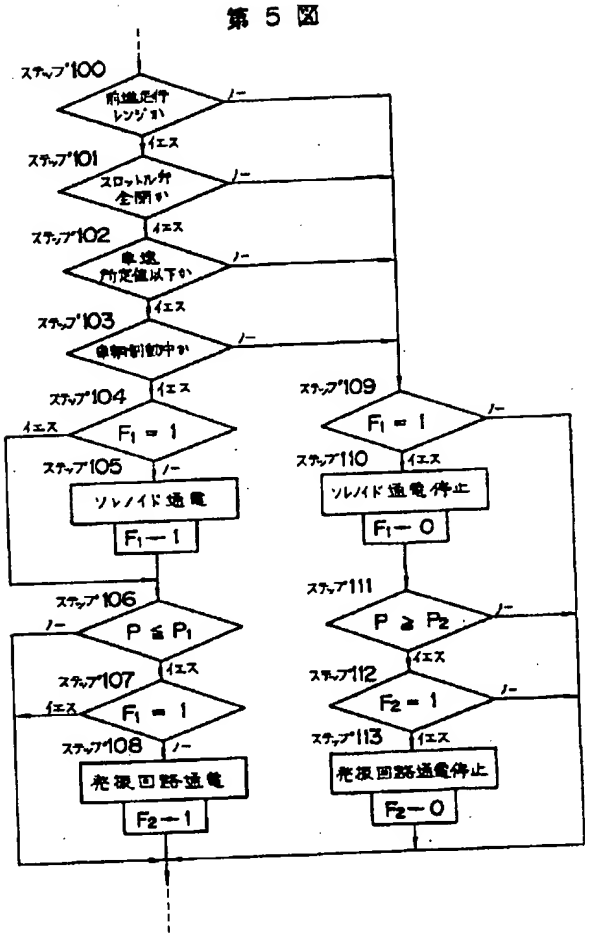

Figure 5

/11

[(S): Step; (N): No; (Y): Yes; (1): Forward drive range; (2): Is the throttle valve fully closed?; (3): Is the vehicular speed equal to or below the specified threshold?; (4): Is the vehicular braking action in progress?; (5): Solenoid current permeation; (6): Oscillation circuit current permeation; (7): Solenoid current permeation termination; (8): Oscillation circuit current permeation termination]